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FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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STATISTICAL FIRE OCCURRENCE PREDICTION AS A PSYCHOLOGICAL TOOL IN FIRE PREVENTION

F. F. CAMERON

Statistician, California Division of Forestry

In 1948, using official census figures and semiofficial intercensus year figures for the State of California as the independent variable, and the numbers of forest and watershed fires on lands protected by the California Division of Forestry for the same years (1933 to 1947, inclusive) as the dependent variable, a linear correlation equation was computed and a high coefficient of positive correlation discovered.

Correlation, in the statistical sense, is a mathematically expressible relationship between two or more numerically definable facts, preferably but not necessarily within the same period in time, which seem to move in like or opposite directions in an organized, and therefore, a predictable manner. The correlation is said to be positive if the components of the series move in like directions, and negative if in opposite directions. The coefficient of correlation is an index moving within the arbitrary limits of plus and minus one, which marks the mathematical degree of the relationship. Plus one indicates perfect positive relationship; minus one, perfect negative relationship; and zero, the absence of any relationship.

The discovery of a high coefficient of positive correlation between the number of forest fires and population suggests that people cause fires. With correlation expressed as a mathematical equation, it may be used to calibrate precise relationships between persons and fires, and, what is more important, to determine, within predefined limits, future relationships between the components of the correlation so that, given a population estimate in the not-too-distant future, the number of forest fires might be computed.

The statistical term for the application of an equation outside the observed limits of the data, i. e., into the future, is extrapolation. Extrapolation is a risky business, and a number of statisticians will have nothing to do with it, preferring to devote their efforts to descriptive statistics. Some statisticians argue, however, that a record of the past is of mighty little value if it cannot be used to determine futurities, and they will fortify their argument by pointing out that even if a few of the conservative statistical principles are violated by extrapolation, a great many sound psychological values accrue in the process; and weighing the loss of one value against the gain of others, they will take what they term the "calculated risk."

Another statistical technique that conservative statisticians avoid is the one known as interpolation. Webster defines interpolation, in the mathematical sense, as "the calculation of intermediate values of a function from observed values according to some assumed law of change in value." The inherent weakness of interpolation as indicated by the definition is, of course, in the word "assumed." That which one statistician will gladly assume in the interests of getting along with his problem, the other statistician will solemnly denounce as unwarranted, unsound, and unwise.

Notwithstanding these warnings a table of 1949 forest fire probabilities was prepared for areas under the protection of the California Division of Forestry, embracing: (1) an extrapolation derived from the equation expressing the average relationship between population and numbers of fires for the prior 15 years as the summation expected; and (2) interpolations on the basis of 6 major administrative units, called districts, for each of the 12 months of the year.

Since it was unnecessary as well as reckless to inform the field of the course that applied statistics was taking in the Fire Control Office, the predictions were not released prior to the fire season. However, as soon as the official figures were compiled, the estimates were compared with them and a remarkable degree of conformity noted.

The over-all prediction, for instance, anticipated 2,453 forest fires during the year. Actually, there were 2,608 such fires during the year, or 155 more than anticipated. However, the over-all figure, or the extrapolation, was not the important figure from a psychological viewpoint. From this point of view, it was the interpolations, or the month by month, district by district figures that were valuable. Since there were 72 such figures, 1 for each of the 12 months for each of the 6 districts, it is impracticable to report the record in detail. However, on the average, each predicted fire-incidence figure missed its actual occurrence counterpart by 12.0 fires.

This isn't too bad from the practical standpoint. In view of the further fact that, on the average, each of the six administrative units for which predictions were prepared is broken into five smaller administrative units, i. e., ranger units, it would be possible to argue that the average "miss" might likewise be broken down to 2.4 fires per ranger unit. From a technical point of view this argument is invalid besides being incapable of proof; but it is cited as an interesting coincidence of that which in point of fact subsequently happened.

The following year a like set of prediction figures was prepared and held in the Fire Control Office for checking against the Ten Day Fire Record when it became available. Again the over-all fire-incidence figure was not too greatly out of line with expectancies, for the record indicated that 2,400 fires broke out as compared with 2,564 anticipated by the chart. The difference, 164 fires, being 6.4 percent of the predicted figure was very like the 6.3-percent differential of the previous year, although in the opposite direction.

Again the primary interest did not center around the over-all differential between the predicted and actual fire-incidence figure but rather around the 72 component differentials that marked the practicability of the interpolations. Here also, however, the table held up rather well—improved in accuracy as a matter of fact—as the average differential was determined to be 9.8 forest fires per district per month.

It was decided in the Fire Control Office that since the trial runs had proved reasonably successful, the fire-prediction program was ready to come out in the open. It was further decided that greater psychological values would develop in a program geared to the smallest selfsustaining administrative unit; i. e., the ranger unit, and the request was made that the prediction figures for 1951 be computed on this basis.

This request raised the number of interpolations from 72 to 360 (30 ranger units x 12 months), but did not, of course, affect the over-all extrapolation. The statistical expectancy in preparing this more detailed table was that percentagewise the differentials would be greater than formerly, but that numerically they would be less. It wasn't seriously expected that the average numerical deviation would approach the postseasonal deviation of 2.4 developed by the unsound techniques previously described, but it was hoped that it wouldn't be too far afield.

In accordance with instructions, the table of 360 predictions was prepared and released by segments to the interested parties in the field. At the time of release a letter was prepared asking the rangers to match their fire records month by month against the segment of the table covering their ranger units, and at the end of the year indicate in letters to the Fire Control Office their personal and organizational reactions to the program.

Before these letters could be received—indeed before they could be written, i. e., in August of 1951—the State Board of Forestry, having been informed of the program, asked for a report on its status as of July 31st. A report was prepared showing that the table of predictions had anticipated 1,168 fires to the end of July and that there had actually been 1,028. It showed also that the average deviation of the 210 interpolations which to that time had been put to the test was 2.2 fires, and that 36 percent of the predictions or 76 of the 210 were "on the nose," that 184 had missed by 5 or fewer fires, and that only 1 had missed the mark by more than 20 fires.

By the end of the year the extrapolated expectancy was 409 fires above the actual record or 15.9 percent. This was largely due to a drastic change in the definition of "forest fire" when we revised our fire report form; approximately 400 refuse and improvement fires, formerly classified as forest fires, were listed separately. However, as before, the major interest centered around the 360 interpolations, the month to month, ranger unit by ranger unit predictions. A tabulation of deviations, signs ignored, appears below. The reader may note that 304 or 84.4 percent of the predictions were within 5 fires of the actual number subsequently

to be suppressed by Division of Forestry crews; that 99 percent came within 20 of the expected number; or that 30 percent of the predictions were "on the nose."

Numerical deviation between expected and actual number of Zones 1-2 forest fires, 1951

Numerical deviation	Number of deviations	Numerical deviation	Number of deviations	Numerical deviation	Number of deviations
0	110	9	3	20	2
1	74	10	5	24	2
2	56	11	1	27	1
3	26	12	1	49	1
4	23	15	1	70	1
5	15	16	1		
6	15	17	3	Total	360
7	14	18	1		
8	2	19	2	Average	3.1

It may likewise be noted that there were 2 cases in which the prediction missed the actual number of fires by a wider numerical margin than seems desirable, i. e., 49 and 70; and that these two cases raised the potential average from 2.8 to the 3.1 that is shown. These, to be sure, appear to be serious miscalculations, the more serious since both of the predictions erred on the side of conservatism. In short, twice during the year a ranger's monthly work load was heavier by 49 or 70 fires than he had been led to anticipate, which is just the sort of apparent miscalculation to undermine confidence in statistical prognosis as a practical psychological tool.

The explanation is rather a simple one. The two underestimates fell in the same month—August—in almost contiguous ranger units that suffered an unprecedented number of lightning fires during a protracted storm. It is coincidence, of course, but in the ranger unit in which the predicted number of fires was 49 less than the actual number for that month, there were 45 forest fires started by lightning, whereas in the ranger unit where the underestimate was 70 fires, the actual number of fires started by lightning strikes was also 70.

This experience, however, drew attention to the fact that no system of statistical prediction can anticipate where or when or how many times lightning may strike and start forest fires. Recognizing this, the State Forester recommended that future estimates include only man-caused fires. For this reason, we are now in the happy position to be able to state that to the end of September 1952 not one of the 270 predictions has missed the actual number of fires by more than 18, and that the average miss for the first 9 months of the year stands at 2.5 fires.

Aside from technical arguments as to the soundness of extrapolation and interpolation as statistical tools, the writer maintains that the psychological value of providing a "par" for fire prevention personnel to shoot at is terrific. For in business, as in sports, the American male asks only for a target to shoot at, a par against which to compare his efforts, a challenge to be met. A prediction of the number of fires that an old-time ranger may expect to have in his administrative area, prepared by a white-collar

worker in the main office who has never even seen a forest fire, is more than a challenge; it's like waving a red flag in front of a bull. Any ranger worth his salt is going to make a liar out of that statistician if he has to stomp out every fire in his ranger unit personally. And this same statistician submits that even if the red flag is shaky statistics, it is pretty fair country style psychology, harnessed and working like a draft mule for the conservation of our natural resource.

To support this contention, it might be pertinent to quote at random from the flood of letters received in the Fire Control Office in response to the request for comments and criticism of the 1951 fire-prediction program. Among these are the following:

The forecast was considered excellent with respect to forest fires. Considerable interest was aroused and a comparison noted month by month.

As an aid to fire prevention work I would suggest a forecast be made of number of fires by causes.

It is felt that any index which can be perfected and which will assist our unit in fire prevention and fire control strategy is definitely a tremendous asset to our over-all problem. We expressly desire to have an expectancy chart prepared for 1952.

We feel it would be of some value to have this prediction continued as it was found to be quite accurate.

As to the value of these prognostications, I feel compelled to state that while they were interesting I see no real practical value to them.

According to the prediction we were to have 48 forest fires; actually we had 63. . . . In view of these inaccuracies it does not seem worthwhile to make these predictions.

This prediction was very helpful to us and would provide us with a rule of thumb for guidance in planning.

Unless we have a more accurate "guesstimate" than in past seasons the information is not usable.

We believe the prediction chart is useful and of value, especially for an over-all State fire expectancy. However the prediction may vary in various localities due to variations of conditions such as winter rainfall, weather during the summer period, etc., which should be evaluated by the persons responsible in each area and allowances made for these conditions.

And then there was the comment and editorial appearing below which seemed to this writer to catch and utilize the spirit of the whole matter.

The prediction given us for our county was used to very good advantage in fire prevention work. While the prediction and the actual fires did not match up very well, it accomplished the purpose. When we first received the 1951 predictions we gave them to the newspapers. The Sentinel gave us a good writeup on them and offered the people of the county a challenge to cut down the fires from the predicted total. Two or three times during the summer this same paper ran articles of comparison on the actual fires and the predictions. At the end of the year when we gave them the totals we received a very nice writeup as well as an editorial on the entire subject complimenting the public and Forestry for a job well done.

The Sentinel editorial follows:

Congratulations folks, you did it!

You made a liar of the statistician, and if we know the fellow he's right happy about it.

The fellow sat there last year at his office in the State Division of Forestry, looked over the records from this County and predicted 63 forest fires for 1951.

Today he can look at some more figures and find out that he reckoned without the fire prevention work of our rural firemen and the residents of the rural areas. Net results were 33 forest fires; and while this is still 33 too many, it sure knocks the predictions into a cocked hat.

How come? Well the Ranger for the Division of Forestry says that residents and visitors in the rural areas have become more conscious of fire prevention. They gave a little more thought to their cigarette butts, they paid more attention to camp fires and warning signs, they were better organized to combat anything that might turn into a fire, and they did enough housecleaning and firebreak building to reduce the danger. . . .

And that is one of the practical and enduring results of a foray into the field of applied statistics. It may have been launched on shaky statistical grounds, but the psychological weapon was a two-edged sword!

Forest Fire Fighting Training Films

[All film 16 mm. color unless otherwise specified. Information on purchase or loan can be obtained from U. S. Forest Service, Washington 25, D. C.]

Name of film	*Length (minutes)*	*Subject matter*
CARGOING & LOADING (Released 1950.)	20	Packaging and loading techniques for airplane dropping of fire supplies and equipment.
CARGO DROPPING (Released 1950.)	20	How cargo is dropped by parachute from Ford Trimotor and DC-3 airplanes to forest fire crews.
CARGO RETRIEVING (Released 1950.)	21	How to retrieve fire supplies, cargo and parachutes from trees.
SMOKEJUMPERS (Released 1947.)	60	Indoctrination, ground training, and jump training of parachute fire fighters.
THE SAWYERS (Released 1949.)	26	Safety training film on correct and safe use and care of the crosscut saw.
THE AXE MAN (Released 1949.)	21	Safety training film on correct and safe use and care of the double-bitted ax.
TRACTORS AND FIRES (Released 1950.)	20	Use of tractors on fire suppression, emphasizing how they speed up work and save manpower. Utah and Idaho.
FOREST SMOKECHASER (Released 1948.)	25	Follows a smokechaser from the time of sighting a timber smoke until he suppresses it. Fundamentals of suppression tactics, scouting, hot-spotting, line building, and mop-up. Locale of film, ponderosa pine belt in Idaho.
SHOVELS, PULASKIS AND MEN. (Released 1948.)	24	Designed to instruct fire wardens, rangers, and others who are responsible for small fire-crew organization in the "how" of training for fighting small forest and brush fires with hand tools. Utah and Idaho.
FIGHTING LARGE FIRES IN BRUSH & GRASS. (Released 1947.)	26	Shows how a fire boss on a large, fast-moving range fire gathers information, analyzes it, plans his action, and executes the plan. Utah and Idaho.
GRASS AND BRUSH FIRE FIGHTING. (Released 1945.)	26	Shows how volunteer crews are organized and the tools and tactics used in fighting grass and brush fires. Utah and Idaho.
A CAMPAIGN FIRE (Black & White; released 1951.)	35	A film on big fire organization—planning the attack, setting up camps, utilizing overhead, and handling crews. California.

(Continued on p. 19.)

REGION 4's FLASH FUEL BURNING INDEX

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With the large increase of flash fuels in the West after the thirties, particularly of cheatgrass brome, there developed a need for a simple, inexpensive device that would help evaluate fire danger in such fuels. A fairly reliable meter was desired for laymen, which would integrate temperature, humidity, and wind, into a burning index. These three factors could be obtained from local weather bureau stations without the need for establishing additional Forest Service fire-weather stations. Any such meter would serve as a guide only, since its success would depend largely on personal judgment.

During the spring of 1946, A. A. Brown, who was working on special fire control projects, was assigned to Region 4 to go over our fire-danger measurement systems and devise a flash fuel burning index. Again it was emphasized that there was need for a "grass" meter that could be readily used by the southern forests and possibly by all forests where an understory of flash fuels was the main problem.

Since obviously it would be desirable to use only one meter and its ratings throughout the region, Brown first tried to adapt the Region 1 burning index meter, which this region was already using in measuring fuel factors in the Idaho pine belt. The R-1 meter failed to reflect fully the degree of fire danger in grass and brush areas and had a further draw-back in that it required daily readings of fuel moisture by the use of fuel-moisture sticks. Brown found that there was very little data available on which to base danger ratings for cheatgrass and similar fuels but that there was a definite relation between humidity, temperature, conditions of annual vegetation, and wind when the larger brush and grass fires started. He devised a scheme taking into account only these four factors. Experience with cheatgrass and other flash fuels in open country shows that high temperatures play a very important part in producing blow-up conditions and that the effect of wind is more decisive than in timber types. For this reason, wind and temperature were given increased emphasis in the rating.

The steps in obtaining a "grass" danger rating are broken into two parts. The first step uses only humidity and temperature to measure weather factors that affect the dryness of fuel (table 1). The maximum rating for these two factors is 50. This part of the rating is separate from the remainder in order to enable a good-size-up of the potential fire danger independent of wind. Wind is the most variable of all factors and can change drastically in a short time. The best basis then for presuppression arrangements is that of the potentialities represented by the condition of fuels

and their moisture content. A strong wind can add an additional 50 points if conditions are otherwise dangerous.

Table 2 shows the additional points for the wind velocity prevailing at any given time. As humidity and fuel moisture increase, wind effect decreases. An illustration of a reading from the tables 1 and 2 follows:

A humidity of 18 with a temperature of 80 will give a fuel rating of 39 from table 1. Referring to table 2, a 5-mile wind will add 18 to make a BI (burning index) of 57; a 10-mile wind gives 71; a 20-mile wind will build it up to 87, a blow-up condition.

TABLE 1.—*Rating for humidity and temperature only, for dry grass in grass, brush, and ponderosa pine types*

Relative humidity	Temperature (° F.)							
	Over 98	91-97	84-90	77-83	70-76	63-69	56-62	Under 56
0-10	50	48	46	43	41	39	37	35
11-15	48	46	44	41	39	37	35	33
16-20	46	43	41	39	37	35	33	31
21-25	43	41	39	36	34	32	30	28
26-30	40	38	36	33	31	29	27	25
31-35	37	35	33	30	28	26	24	22
36-40	33	31	29	26	24	22	20	18
41-50	29	27	25	22	20	18	16	14
51-60	23	21	19	16	14	12	10	8
61 up	15	13	11	8	6	4	2	0

TABLE 2.—*Wind rating values to add to table 1, for dry grass in grass, brush, and ponderosa pine types*

Wind (m.p.h.)	Rating value for a relative humidity of							
	0-20[1]	21-25	26-30	31-35	36-40	41-50	51-60	61 up
0- 2.5	8	7	6	5	5	3	2	1
3- 4	12	11	10	8	7	5	2	1
5- 6	18	16	14	13	11	7	4	2
7- 8	25	23	20	17	13	10	5	3
9-10	32	29	26	22	19	13	6	3
11-12	38	34	30	27	23	15	8	4
13-14	42	38	34	29	25	17	8	4
15-17	46	41	37	32	28	18	9	5
18-20	48	43	38	34	29	19	10	5
21-24	49	44	39	34	29	20	10	5
25 plus	50	45	40	35	30	20	10	5

[1] 100 percent allowance for wind effects for humidities under 20.

To the burning index, obtained above, a judgment factor based on volume, density, and flammability of grass and other fuels must be applied for any particular area. The following series of reminder situations are used as part of the instructions for applying the ratings from the meter. They represent the judgment factor.

1. *Cheatgrass completely cured.*
   a. Dense and continuous enough to carry fire alone. (Full grass BI rating applies.)
   b. Heavy but too broken by less flammable fuels to support continuous spread. (Very flashy, reduced grass BI.)
   c. Too sparse to carry fire alone. (Reduce grass BI to condition of associated fuels.)

2. *Cheatgrass curing.*
   a. Cured and flammable only on exposed slopes.
      (Grass BI applies to restricted areas.)
   b. Not cured enough to carry fire alone. (Reduce grass BI to condition of associated fuels.)
3. *Cheatgrass green.*
   (Rate only on basis of other fuels.)

A daily record of the grass burning index is valuable in keeping the personnel of our regional office currently informed of general fire-weather conditions throughout the region. Eleven weather stations broadly representative of the region were selected out of many that report daily to the Hill Air Force Base, Ogden, Utah. This base weather station notifies the regional clerk daily by telephone of humidity, temperature, and wind readings for these selected stations. The information is recorded and the data converted to a general grass BI reading. A glance at the record shows personnel the danger areas, since all BI's over 75 are recorded in red.

After using this grass BI for 5 years, we have found it a good general indicator of serious emergency conditions, a sound fire control planning device, and a reasonably accurate measure of flash fuel danger. The State Foresters of Utah and Nevada are also using this meter and they find that it keeps their people aware of danger trends and helps them evaluate the local fire-weather conditions. In Utah, county sheriffs, who are charged with the fire protection of S&P lands, use it as a guide in issuing burning permits. The Utah State Forester has provided all wardens with a pocket-size card based upon the meter for their use during the fire season.

Snap-On Pulaski Sheath

We in this area, and I am sure others, have had trouble keeping pulaskis properly sheathed. Tom Coski of the Payette National Forest has developed a simple and inexpensive sheath, made of old fire hose, which we feel is the answer to the problem.

The complete pulaski sheath can be constructed from a 17-inch length of 2½-inch unlined fire hose, plus 6½ inches of ¾-inch bungee tape and two snap buttons. Actually there are two individual sheaths, one for the ax and another for the hoe. Both sheaths are made in the same manner except for dimensions.

A length of hose is split along one side and cut to the proper pattern. The middle flap is folded down. The larger end flap with the male part of the snap fastener attached is then folded over and sewed to the middle flap. The sheath is then placed on the pulaski and the other end flap with the bungee and female part of the fastener attached is snapped on. The bungee assures a proper fit and makes the sheath self-adjusting.

When not on a pulaski the two sheaths can be snapped together and placed in a shirt or pants pocket, where they are out of the way and not as likely to be lost as the heavier and more expensive commercial sheaths.

These sheaths are being manufactured at the Smokejumper Parachute Loft, Payette National Forest, McCall, Idaho, and are available for purchase through Procurement and Supply, U. S. Forest Service, Region 4, Ogden, Utah.—REID JACKSON, *Forester, Payette National Forest.*

THE ROLE OF BURNING INDEX IN FIRE-DANGER ESTIMATION

JOHN S. CROSBY

Forester, Central States Forest Experiment Station

The factors that are used to make up a burning index meter rating and the locations at which these factors are measured determine to a large extent how the rating should be used. Meter ratings used in the eastern part of the United States are based on fuel moisture, wind velocity, and condition of vegetation. These factors, which affect the burning of fuels, are integrated to provide a single index number or rating, a burning index. The location of stations and exposure of instruments used in connection with any one meter are standardized to make ratings comparable between stations. Burning index alone is not a complete measure of fire danger. However, if adequately supported, burning index is a good tool for use in estimating total fire danger.

Fire danger is more than burning index. Fire danger may vary from place to place and from season to season even at the same burning index rating because of (1) differences in the general level of fire occurrence; (2) differences in fuel, cover, soils, elevation, topography, and aspect that cause variation in the behavior of fires and difficulty in controlling fires; and (3) differences in the damage that may be done to the resources protected. Daily presuppression organization and planning at the district level must be related to the total fire danger to be most efficient. Although burning index is a good starting point, it must be supplemented by local consideration of these other factors in order to properly rate the fire danger.

Many of these modifying factors can be quantitatively correlated with burning index. This permits more reliable estimates of current fire danger and thereby makes the burning index meter a more valuable tool. For example, an analysis of Lake States data showed that there is a consistent relation between fire occurrence and burning index as rated by the Lake States Burning Index Meter. A preliminary analysis of Missouri data indicates that there is also a correlation of fire occurrence with the ratings of the Central States Meter. An increase in burning index is accompanied by a corresponding increase in the rate of fire occurrence. It can be assumed, then, that an area having generally high fire occurrence will have more fires at any level of burning index than an area where fire occurrence is generally low. This means that at any level of burning index the fire danger is greater on a district that has high fire occurrence than on a district that has generally low fire occurrence. Presuppression activities may have to be organized at a lower burning index on the high occurrence district than on the low occurrence district.

The influence of fuel and cover on fire behavior will affect the danger and must also be estimated. Fire behavior becomes more dynamic as burning index increases, but different fuels, or similar fuels modified by different forest cover, will exhibit different characteristic fire behavior with the same burning index rating. The difference in fire behavior may be explained in two ways. One, the burning index is taken at a standard location which gives a rating that may be higher or lower than the rating obtained under different conditions of cover and position; and, two, there is a real difference in fire behavior resulting from the burning of different kinds, sizes, shapes, and positions of fuels or aggregations of fuels. To illustrate, a study in the Lake States showed that at a given burning index and given wind velocity, rate of spread of fire was greater in open country and open stands than in dense forests, and that light loose fuels permitted higher rates of spread of fire than did heavy fuels. Fire danger may, therefore, differ significantly between districts or parts of the same district, because of different prevailing cover and fuels.

Difficulty of controlling fires and probable damage are also factors of fire danger. In any locality the difficulty of suppressing a fire increases with burning index. In the Northeast,[1] fire damage has been related to burning index. The burning index points the way but does not specifically rate the amount of damage or the difficulty of control. The quantitative relations must be worked out locally in order to use them in the equation of fire danger.

Burning index by itself is an isolated statistic. When it is given meaning in terms of fire occurrence, fire behavior, difficulty of controlling fires, and possible damage, it is a sound basis for estimating fire danger and provides more precise information on which to plan and organize fire control activities.

[1] FOREST FIRE DAMAGE APPRAISAL PROCEDURES AND TABLES FOR THE NORTHEAST. A. W. LINDENMUTH, JR., J. J. KEETCH, AND RALPH M. NELSON. Sta. Paper 11. Southeast Forest Exp. Sta., Asheville, N. C. 1951.

Combination Wheel Chock and Jack Block

Have you ever attempted to use a truck jack whose lifting height was insufficient and there was nothing at hand to shim under it? A wheel chock, recommended as safety equipment on all tank trucks, can serve a dual purpose and compensate for this deficiency.

Rear axles of many vehicles are of such a height that the provided jack will not raise the wheel sufficiently to allow for a tire change. The chock not only eliminates this problem but offers greater stability when elevating a vehicle on loose earth or gravel, and better leverage for operating the handle. The chock is of simple design. It is a 6- by 8-inch block of wood, 12 inches long, and sawed at a 45° angle. Metal stripping around the edges precludes splintering, and an attached pull rope makes for ease of handling.—D. C. BIEDEBACH, *Fire Crew Foreman, Angeles National Forest.*

MECHANICAL TRAIL TRANSPORTATION

LAWRENCE A. WAGGENER, JR.

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With the completion of several "mechanized" trails, that is, trails specifically designed for use by mechanical trail equipment, mechanical trail transportation is being used to advantage in several locations in Region 6. However, builders of these trails have unintentionally been responsible for the defeat, in part, of the program they were endeavoring to exploit. Limited attention was given to advance location. In many cases no emphasis was placed on this very important part of trail planning and construction.

What are the results? The most common are steep grades often occurring in unfavorable soil conditions, unnecessary adverse grades, switch-backs that are costly to construct, and poor drainage.

Much has been said about tractors and other machinery used in the construction of these trails. In the past, efforts have been directed toward design and construction of this equipment while transportation units such as the trail "mule" and the scooter have not received sufficient attention.

The primary purpose of a "mechanized" trail is to provide fast, efficient transportation of men and equipment to remote areas for the suppression of fires. We are learning rapidly that this transportation can be used effectively and economically in many other activities, such as engineering and timber management.

It was known that some transportation vehicle was needed, and experiments were made with several special trail trucks of varying design. While these carried desirable loads, handled well, and furnished good traction, their lack of maneuverability on switchbacks, etc., made them unsuitable. This brought about the trail "mule." Its design enables it to negotiate extremely short radius turns with little difficulty (fig. 1).

The trail "mule" is somewhat intricate in design but simple to operate. It does have limitations. It requires reasonable footing—a relatively compact and smooth tread of dirt or gravel—and moderate gradients. These should be held to sustained grades averaging 10 percent with occasional short pitches of 15 percent. The latter should be allowed only where advance location determines such practice necessary. Under these conditions the "mule" will average satisfactorily 8 to 10 m. p. h. with a near-capacity load.

FIGURE 1.—The trail "mule" can climb grades of up to 10 percent, short pitches up to 15 percent, at speeds of 8 to 10 miles per hour. Four or five men can ride in the trailer.

The scooter (fig. 2) requires similar trail conditions. It provides speedy transportation for one rider and miscellaneous gear. For both vehicles highway travel between headquarters and trail ends is practical where distances are reasonable.

Originally, an attempt was made to smooth the tread of a trail by back-blading with a tractor-trailbuilder. The results were not satisfactory. Drags and a drawbar type grader were employed next. With the advent of the trail patrol grader (fig. 3) in 1949 the problem of properly conditioning the trail for vehicle travel was accomplished more satisfactorily. It enables the operator to install ditches and dips, turnpike fill sections, and provide a smooth tread. This use has improved greatly the performance of the trail "mule." Higher speed, smoother ride, less operator fatigue, and reduced mechanical breakdown are the results. In addition, proper use of the grader has conditioned trails to withstand the elements of weather, erosion, etc., reducing maintenance problems and costs significantly.

Some Forest Service officials have argued that value received from a "mechanized" trail system will not offset its higher construction cost. Like a truck trail, it must be engineered if it is to be adequate. However, field personnel that use these trails have learned that lookouts can be serviced faster and at less cost than by using pack stock. Foot travel over them requires less effort, and if fire crews must travel afoot, they are less tired and more ready to go to work upon arrival.

FIGURE 2.—The trail scooter provides rapid one-man transportation when trails are constructed on reasonable gradients.

FIGURE 3.—The secret to mechanized trail maintenance is the trail patrol grader.

Administrators have learned that these trails have other uses. While their primary purpose is in fire suppression, one supervisor forecasts that the trails will more than pay for themselves while timber cruising, road location, and sale activities are underway. Use of the trail and equipment for transporting crews will eliminate costly camps and much slow foot travel which would mean, in this heavily timbered and rugged terrain, saving a considerable sum. He further prophesies that a future road to replace the trail will frequently follow the trail location, thereby reducing clearing and burning costs appreciably.

"Mechanized" trails as an avenue of rapid access to remote areas are a reality. Their potential has yet to be appreciated. Because of higher costs of construction, however, they should be built only where speed and long-term economy offer a decided advantage to the Government. Administrators should be encouraged to consider these trails rather than shy away from them when determining means of access to back country areas. This is especially true where travel is essential but major improvements or roads will be slow in development.

Life-Size Paper Smokey Bear

A cheap, effective Smokey Bear was made by forest personnel on the Mendocino and used during the past season on floats in parades and at County Fairs. Smokey is especially effective in drawing the attention of children. The Smokey Bear pictured here is about 5 feet 6 inches high, has a 56-inch waist, and weighs about 45 pounds. He cost about $12 and the material used was as follows:

Base framework.—2 1- by 4-inch uprights passing through body from feet to shoulders; they pass through 2 ¾-inch plywood boards at waist and chest, cut to shape body.

Feet.—2 by 4's, 14 inches long.

Shoulders.—A 1 by 4-inch.

Arms.—2 by 4's.

Head.—¾-inch plywood outline nailed to shoulder frame.

Hat brim.—¼-inch plywood; crown shaped from plywood and wire.

Covering for framework.—¼-inch mesh chicken wire, crimped and shaped.

Covering from waist up.—Newspapers soaked in paste made from ½ cup paperhanger's glue and 3 gallons of water.

Eyes.—Glass.

Finishing.—Spanish brown water paint with some black enamel brushed on lightly to give impression of hair. Nose, black enamel and white paint.

Hands.—Cotton gloves.

Overalls.—56-inch stock.

J. N. EWING, *Forest Engineer, Mendocino National Forest.*

TIME CLOCKS ON LOOKOUT RADIO EQUIPMENT

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Communications Technician, Stanislaus National Forest

Until 1946 a telephone system installed in the early 1930's was the main source of communication between the lookouts and the fire dispatcher of the Stanislaus National Forest. Since then a radio network has been developed which provides communication with mobile units in the field as well as with the fixed ranger stations and fire dispatcher. Of eleven manned lookouts nine are provided with dry battery-operated radio equipment; the other two use telephone. It has been forest policy to have the lookout operator keep the radio on during his normal working time of 8 to 10 hours each day. Should he detect a fire at night he can always turn on the radio and report it, but should the dispatcher receive a report of a fire it has been impossible for him to reach the lookout by radio.

The radio network has become the primary source of communication and yet it has been necessary to maintain the telephone system in order to reach the lookouts when their receivers are not operating. It was felt that the additional expense of operating the radio 24 hours a day was not justified in the occasional need for calling a lookout.

The age of the telephone system has necessitated higher costs of maintenance, and much of the line is due for reconstruction. Because of the primary use of the radio network, large expenditures for telephone maintenance and reconstruction are more difficult to justify.

It was felt that if some means could be devised to communicate with the lookout at night without the heavy battery drain caused by having the receiver on all night, it would be possible to eliminate some of the telephone line. It was decided to incorporate in the lookout radio system a time clock which provided for automatically turning on the radio receiver each hour for 5 minutes, then turning it off. In this way anyone desiring to communicate with the lookout at night could do so during the 5 minutes when his receiver was energized. Once called the lookout could switch over to continuous operation for any period.

After considerable search a time clock was located which could be modified to accomplish the desired operation. The clock will run for 30 days on one winding, is accurate to 5 minutes per month, and while designed to control an electrical circuit once a day, could be modified for hourly operation.

Using this method it may be necessary to wait as long as 55 minutes to reach the lookout but this must be weighed against the additional battery expense of 24-hour operation. With the time

clock the increase in battery consumption is approximately 18 percent more than that of the normal 8-hour day as compared with some 200 percent if the receiver is left on continuously.

It was determined that substantial savings could be effected if five of the eleven lookouts were equipped with the clocks. The others had telephone lines which could be easily maintained or were not equipped with radio. Two of the five lookouts had separate sleeping quarters on the ground and required the installation of remote controls from the radio equipment in the towers. The other three had the sleeping quarters in the towers.

Five clocks were modified and each equipped with a switch to select either periodic or continuous operation. Adapting cables and wiring were designed so that a clock could be inserted in the radio wiring system without modifying the basic equipment (Type T model D). A pilot light installed on the clock gave the lookout a visual indication of when the clock operated the system. This is so the operator can have his radio turned on and still report to the dispatcher the time of the hour that the clock would operate.

These clocks were installed during May and June 1952 and have been in use all season. The dispatcher makes a weekly check of the "clock time" from each lookout and this record serves the dual purpose of furnishing him with the exact time he should call a particular lookout at night and giving the radio technician a record of clock performance. The fire control assistants of each district were made responsible for winding and setting the clocks. This year all clocks were set to operate on the hour, but next year a plan of setting clocks by areas or districts is to be tried. The thought is that then only one area or district can be called without awakening all lookouts.

The operation for the first year has been very successful and each time a lookout was wanted he was reached without difficulty. Next year it is planned to install additional clocks in lookouts and to extend their use to mobile units at guard stations by placing an extension speaker in the sleeping quarters and having the clock turn on the mobile receiver.

Fire-Weather Division Activated in Shreveport

A full-time Fire-Weather Division was activated by the Shreveport office of the U. S. Weather Bureau on March 1, according to State Forester James E. Mixon of Louisiana. The division will interpret hourly weather information into fire-weather forecasts for the benefit of forestry agencies in Louisiana, Texas, Oklahoma, Arkansas, and Mississippi.

Mixon said that this service has been furnished Texas since 1948 and has proved valuable to State foresters in planning fire operations. Daily fire-weather forecasts by the Shreveport office were initiated in Louisiana during the October emergency and have been continued. Personnel who have had experience in this type of reporting will be transferred to Shreveport from stations in the North and West.

The State Forester praised the action taken by the bureau as "another example of cooperation between government agencies" to solve a difficult problem. He said that the information, which is phoned twice daily to the commission office in Baton Rouge, is transmitted by radio to every tower in the State.—ED. KERR, *Press Representative, Louisiana Forestry Commission.*

BATTERY BOXES FOR TF AND MOTOROLA REPEATERS

FRANCIS W. WOODS

Communications Officer, Region 4, U. S. Forest Service

Two years ago it became apparent that something should be done to simplify the battery replacement problem on dry battery-operated repeaters. Equipment was being damaged when batteries were replaced, and too much of the radio technician's time was taken each spring to make the reinstallations.

It was decided to build a heavy duty battery box and to use No. 6 cells for both A and B supply on the receivers. The new box was to have a spring arrangement in the lid wired so that the lookout or anyone could simply open the box and place the proper number of No. 6 cells. Then when the lid was closed the batteries would be properly wired and would not have to be oriented.

The first battery box designed was similar to the old SPF kit box, but it wasn't satisfactory because the lid was so wide that it bowed up slightly, causing loose connections. John Barkdull, Boise technician, redesigned the battery box, using 3/4-inch plywood for all but the top spacer which is $\frac{3}{8}$-inch plywood (fig. 1). A spring had been designed earlier for two outside contacts, and a die made to punch the spring. Barkdull, in redesigning, made two inside contacts by cutting one on the outside. The die, which cost approximately $250, is the property of the Forest Service and is available for use anywhere in the Service.

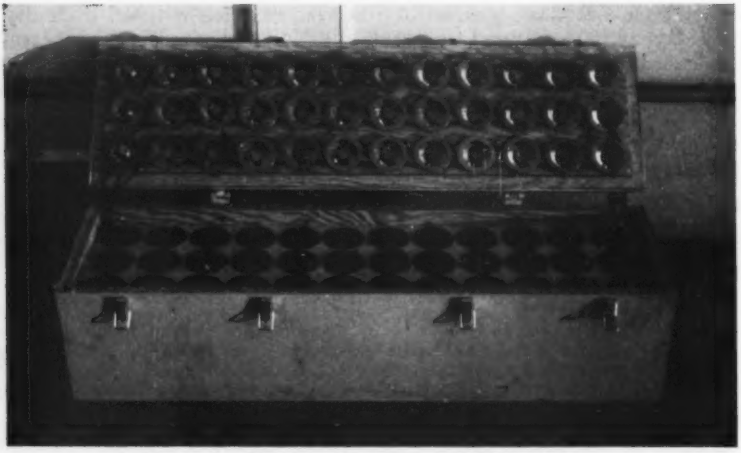

FIGURE 1.—Interior arrangement of battery box.

One box completely assembled with the springs, battery cable, and plugs costs about $17, and one man can assemble and wire two boxes a day. On the Boise National Forest 13 repeaters were used last summer without failure (fig. 2). One set was in service from July 1 to November 3—4 months of continuous 24-hour stand-by service. Receiver A battery on this unit dropped 0.25 volt and B battery 6 volts. Motorola repeater units used with these boxes lasted comparable periods.

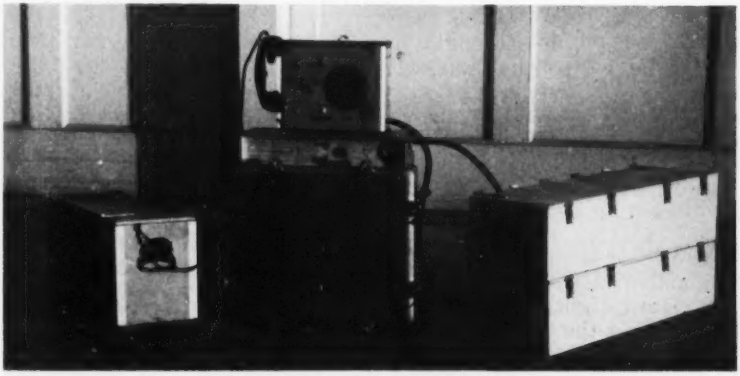

FIGURE 2.—TF relay, showing battery boxes and cable.

Forest Fire Fighting Training Films—Continued

Name of film	*Length (minutes)*	*Subject matter*
HELICOPTERS & FOREST FIRES. (Released 1950.)	20	Operation and use of helicopters in fighting forest fires; emphasizes proper techniques and safety for personnel flown to inaccessible areas. California.
FOREST FIRE AND WATER.... (Released 1952.)	10	Shows application of water on fire and desirable methods of water application. California.
ONLY A BUNCH OF TOOLS.... (Released 1949.)	26	Deals with recruiting and training of volunteer crews in fighting forest fires in the Northeast. Illustrates the complete organization for fire fighting agencies in these States.
FIRE IN THE FOREST..... (Released 1951.)	26	Shows conditions that cause small fires to become large, disastrous ones. Locale Northeastern States.
BUILDING THE FIRE LINE (Released 1951.)	20-25	Depicts a warden organization handling a fire suppression job from beginning to end in Northeastern States.
WATER ON THE FIRE..... (Released 1952.)	30	Filmed in Connecticut. Deals with efficient use of water and water equipment in fire suppression.
FOREST FIRE FIGHTING IN THE SOUTH. (Released 1945.)	39	Demonstration of types and proper use of hand tools used in fighting fires in the South.

THE ALEUT PACK STRAP

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The problem of packing and carrying smokejumper gear after a practice or fire jump has been lessened by the use of the Aleut pack strap. The strap is of simple construction, very light weight, and it can be adapted to almost any type of man load (fig. 1). The design for the pack strap was introduced to the Region 4 smokejumpers by civilian instructors of the U. S. Air Force Survival School, McCall, Idaho. Fifty of these straps were manufactured and tested by Region 4 smokejumpers with the following findings:

1. The strap is best adapted to large, loosely packed loads. This type of load when covered with a thin manta tends to form itself to a man's back and makes an ideal pack (fig. 2).
2. Hard, tightly packed loads tend to shift and are uncomfortable against the back.
3. The shoulder bind, age-old curse of the man pack, is eliminated to a large extent. The weight of the load is distributed across the chest instead of the shoulders and enables a man to carry a heavier load with more comfort.
4. A safety factor is also involved. When packing in steep country there is less danger of rolling with a pack when this type of strap is used. The parachute cord holding the load in place can be attached to the grommets with a slip knot, and the whole load can be instantly dumped if an emergency arises.
5. When not in use the pack strap can be rolled up into a compact unit about the size of a softball.

The pack strap is attached to the pack in the following manner: The packer first places the parachute cord around the pack with the chest strap on top and facing the side of the pack that is to rest against his back. He then sits down with his back against the pack and places the chest strap over his head and down to his chest. The shoulder straps are now in the proper position. The cord running around and under the pack is brought up and tied through the grommets on either side of the chest strap. He then stands and adjusts the pack elevation by taking up or feeding out cord through the grommets. The cord is then tied to the chest strap.

These pack straps, constructed of C-8 webbing, are manufactured at the Smokejumper Parachute Loft, Payette National Forest, McCall, Idaho, and can be purchased through Procurement and Supply, U. S. Forest Service, Region 4, Ogden, Utah.

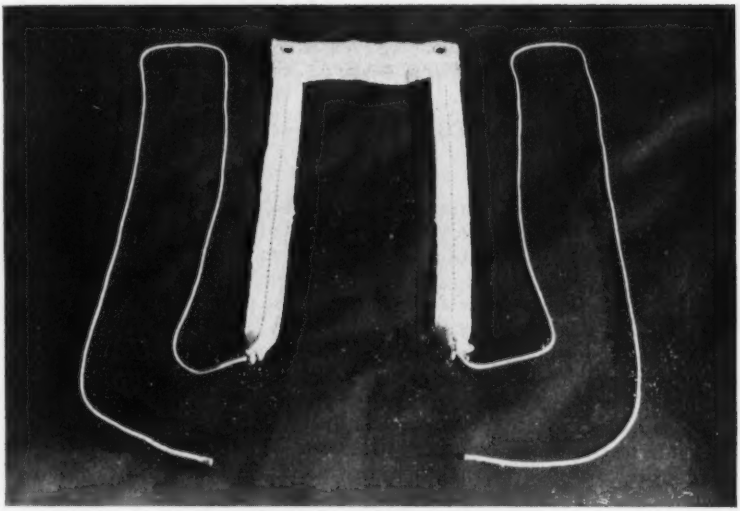

FIGURE 1.—The Aleut pack strap.

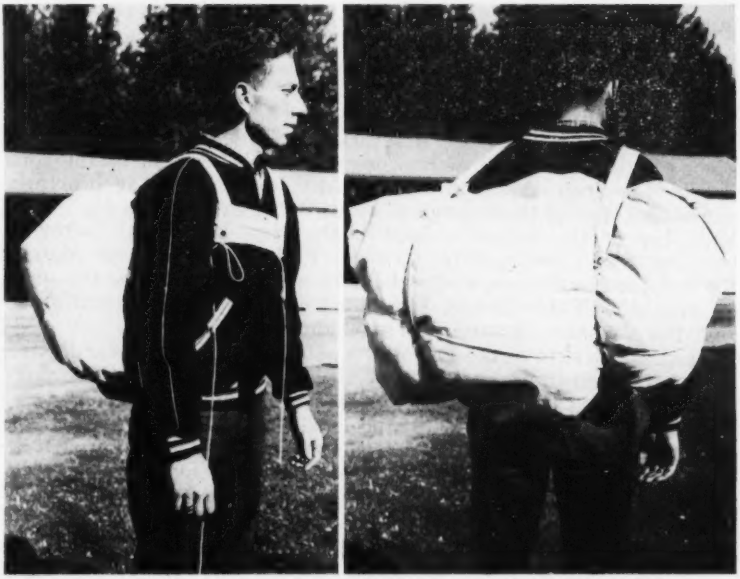

FIGURE 2.—Aleut pack strap in use. Note even distribution of load across chest.

A SAFE, CHEAP, AND EFFECTIVE FOREST FIRE GRENADE

R. L. FENNER

Range Conservationist, California Forest and Range Experiment Station [1]

A general purpose forest fire grenade has been developed that is safe to use, and it can be produced at low cost. Though not suitable for use in vegetation where there is no ground fuel, the grenade provides a fast, sure way to ignite grass, pine needles, and hardwood-leaf fuels from a distance of 200 feet. With this grenade, ignition patterns can be used to build up the volume of fire or to regulate drafts inside the fire line.

Drawbacks to the use of grenades in numbers sufficient to accomplish their purposes have been the high cost of the grenades and the dangers involved in handling and igniting them. This grenade has had sufficient trial to point out how it meets the fire fighters' and users' requirements of safety, effectiveness, and low cost.

The grenade consists of four essential parts: incendiary charge, fuse-primer, skin, and striking tip (fig. 1). Although the design is simple, considerable care and experience are needed to assemble sure-fire grenades.

Incendiary charge.—The charge consists of a 1-inch section of standard fusee with a 9/32-inch hole bored through the center of the section. The hole must be this large to prevent smothering of the reaction when the primer ignites the incendiary charge.

Fuse-primer.—The fuse and primer are made from a single piece of spitter cord 10 inches long. A 3-inch segment of the cord is folded back on itself and then refolded to form a 1½ inch primer consisting of four thicknesses of cord. This leaves a fuse 4½ inches long. Use of this simple primer is the most important factor in constructing a cheap, safe grenade. The primer is inserted into the hole in the charge, and is held in place by crimping the ends on each side of the charge. Care must be used in this operation so that the air space through the grenade is not blocked.

Skin.—The skin of the grenade consists of a 7/8-inch cardboard tube 1/16-inch thick and an over-all covering material. The purpose of the skin is twofold: (1) A directional shape is given to the flame (fig. 2) by the slow-burning cardboard tube; and (2) after the grenade is assembled, the crumbly portion exposed by cutting and drilling the fusee is held in place by the over-all covering material. Masking tape is a satisfactory cover, but for quantity production the assembled grenade is dipped into highly flammable plastic.

[1] Maintained by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of California at Berkeley, Calif.

Striking tip.—Paper safety matches are fastened to the fuse tip so that it can be ignited by pulling between two surfaces covered with the striking compound used on safety match box covers.

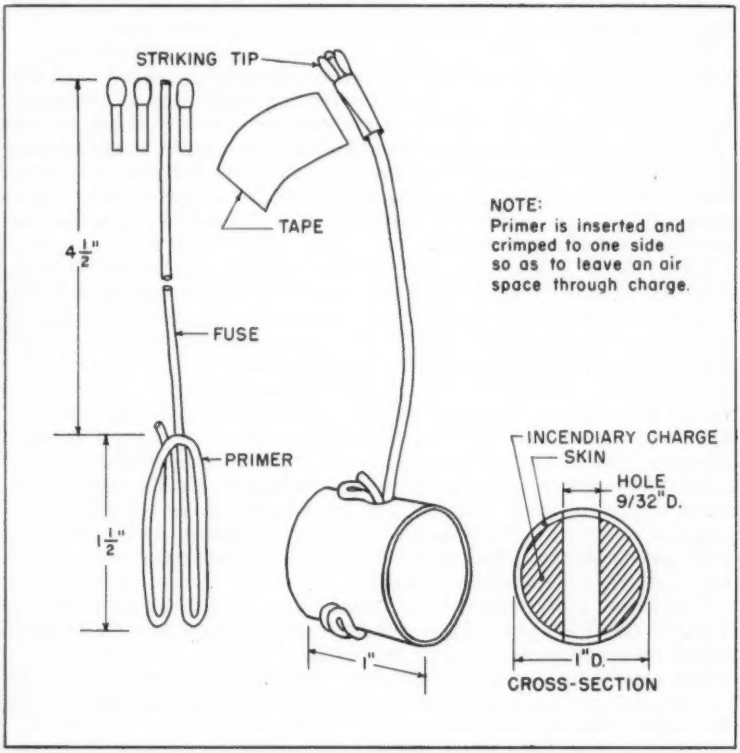

FIGURE 1.—Construction details of Fenner fire grenade.

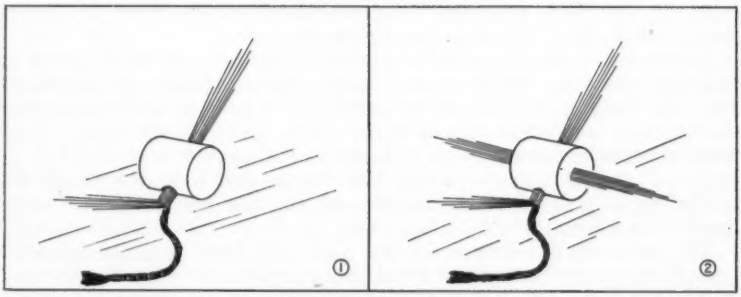

FIGURE 2.—Flame of Fenner fire grenade: (1) during first 15 seconds after ignition; (2) during next 20 seconds.

Experience with the grenade has given the following information on how well it meets the requirements of safety, low cost, and effectiveness.

Safety.—The grenade does not contain explosive or poisonous compounds. The charge is stable and contains no flammable liquid, and the primer does not contain an explosive cap.

The grenades are not easily ignited by accident and can be handled and stored with relative safety. Greater caution is needed, however, than is ordinarily required for handling and storing fusees because of the matches and exposed black powder on the tip of the fuse. The grenades should always be stored in containers that keep out sparks or flames. The grenades should never be carried in pockets or in containers that cannot be readily jettisoned in case of accidental ignition. The incendiary charge can be extinguished with water.

Elementary precautions should be taken in lighting the fuse. It should be ignited only at the tip and with the tip pointing away from the body and from other grenades. Also, it should be ignited only after selecting the spot into which the grenade is to be thrown. Once ignited, the fuse burns 8 seconds.

Cost.—The grenade is relatively inexpensive. Since only common materials and no cap igniting primer are needed, raw materials for a grenade cost about 5 cents. An experienced worker using hand tools can fabricate about 20 grenades an hour.

Effectiveness.—Large numbers of grenades can be carried because of their small size and light weight—about 35 fit in a 1-pound coffee can. They can be thrown by hand up to 100 feet. With an ordinary sling shot, they can be projected up to 200 feet. Accuracy depends on practice.

With proper striking tips, grenades can be ignited and thrown at the rate of 20 per minute. Without a tip they can be ignited with a match, cigarette, punk, or fusee.

The 8-second fuse allows time for throwing or projecting from a sling shot and allows the grenade to reach the ground before the incendiary charge ignites.

Once the fuse is lit a properly constructed grenade will always fire. Misfires have always been traced back to improper construction. In one test, a group of grenades fired consistently after being submerged in water for 3 minutes.

The flame is two-pointed for about 15 seconds and then forms a four-pointed star for 20 seconds as it reaches maximum intensity (fig. 2). Because of this shape some fire is always directed along the ground surface regardless of how the grenade falls. The flame covers an area about 6 inches in diameter and reaches a height of 1 foot with no wind. The flames are intense enough to ignite fuels 1 inch in diameter next to the grenade, and will ignite fine fuels up to 6 inches away.

The grenade is being produced and used only in experimental quantities at present. Additional information covering the device will be available through the California Forest and Range Experiment Station.

SIRENS ON AIRPLANES SUMMON WOODS WORKERS FOR FIRE FIGHTING

WILLIAM J. EMERSON

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Woods workers are the handiest and best source of labor for fire fighting on the Superior National Forest in Minnesota. These men are present in sizeable numbers on logging operations, but during the day when they are needed for fire, they are scattered far and wide through large areas of woods, engaged in cutting and skidding timber. With the present trend toward scattered "shacker" groups and away from the large logging camps, many of these workers also eat and sleep in remote, isolated groups of portable shacks close to their work. Thus the problem of getting large numbers of these scattered woods workers on fires during the early stages is a difficult and critical one. In the past, they were summoned by means of messenger, usually on foot, after the request for fire fighters had been sent by car or called via telephone to the logging headquarters. This was a very slow process and sometimes the resulting lag in attack on the fire was very costly. The problem was how to quickly reach any needed number of these groups of men in the woods to summon them out for fire fighting.

Trials were made with certain types of ground signals, such as smoke bombs, and explosive bombs launched from the ground to explode in the air with a loud report. Such signals proved rather ineffective and sometimes unsafe to use.

With the large numbers of power saws and tractors operating among these woods workers, it seemed that we needed a signal which would be both seen and heard by practically the entire group of scattered timber workers. The use of airplanes looked like part of the answer. But how to signal large numbers of men from the air with a positive and easily understood message, without tying up the airplane for an excessive time in the act?

First, an electric megaphone was tried from an airplane. This was quite effective from a light plane when a message was to be delivered to someone in one spot. But its use to call a message to scores of men scattered over hundreds of acres in the woods was found to be ineffective and usually confusing. Some groups of men would not hear the megaphone unless it was directed straight toward them at a relatively close distance. Some men would misunderstand and place their own interpretation on the words they heard, or thought they heard, from the megaphone. So it was decided to confine use of the electric megaphone to calling specific messages to individuals or to small local spots on fires.

Next a siren was tried on the airplane to determine its effectiveness in calling out the large groups. It was found that a light airplane flying a few times back and forth over a large area, blowing a siren, was very effective in summoning the scattered workers, after their foremen had told them that the airplane siren was

the signal to immediately leave the woods and report to their camp for specific instructions. There seems to be little chance for misunderstanding, confusion, and delay, after the logging supervisors have instructed their workers to respond to the siren. The airplane can then drop a message to the camp or headquarters where the men will report, giving the location of the fire and any other necessary instructions.

All timber operators having sizable numbers of loggers in the woods during the fire season are being contacted and requested to advise their men of the meaning of the airplane siren signal. Permission will be secured from the operator before his men are summoned in this manner.

In order to have the airplane sirens always available and ready to use, the Superior National Forest installed sirens permanently on each of its three seaplanes. Thus, by radio through the central dispatcher, the planes can be dispatched from their existing positions to fly over any given logging area to sound the siren and thus start mobilization of the woods workers for the fire. The dispatcher and pilots have in their possession maps showing current principal logging areas with the approximate number of men working in each one. These maps, which will be brought up to date annually by the district rangers, will furnish a ready reference when a plane is dispatched to fly over specific areas to summon men out by means of the siren.

There is a big advantage, of course, in being able to install sirens permanently on the planes so there will be no delay incurred in installing the siren each time it is needed. Forest protection agencies not owning airplanes should be able to arrange for installation of a siren on their charter plane where contract or agreement exists for use of one or more specific airplanes during the fire season. Ordinarily, before installing and using a siren, or any other accessory or addition, on an airplane, a CAA Form 337, Repair and Alteration Form, should be made and approved by CAA.

The following description of siren installations on the Superior National Forest's airplanes will serve to illustrate types of sirens that may be used and ways of powering them:

1. Piper Cub two-place seaplane. Wind-driven siren mounted on lift strut, left side, close to fusilage (fig. 1, left). Siren is activated by its own 10-inch propeller, which is released and stopped by a control connected through a flexible cable with the instrument panel.

2. Stinson Station Wagon four-place seaplane. Electric automobile-type 6-volt siren mounted on small step, left side, just ahead of lift struts, alongside fusilage (fig. 1, right). Power is 6 volts taken off the plane's 12-volt battery on a separate circuit fused close to the battery. Control is by a switch on the instrument panel.

3. Noorduyn-Norseman nine-place seaplane. Electric automobile-type 6-volt siren, same type as used on fire trucks, mounted on right side on bracket attached to top of rear float strut. Power is

6 volts taken off the plane's 24-volt battery on separate circuit fused close to battery. Control is by switch on instrument panel.

The Cub and Stinson sirens are very effective and quite easily heard on the ground from elevations up to 1,000 feet. The engine noise of the larger Norseman plane tends to drown out about 30 to 50 percent of the siren signal, and since the Norseman is not flown at low elevations if this can be avoided, the siren is not as effective as those on the light planes. However, it is sufficiently loud to be heard by men in the woods.

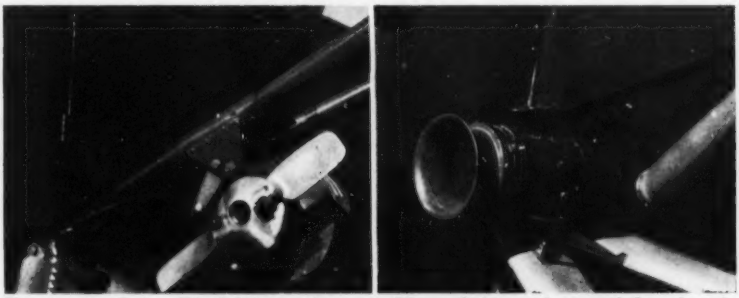

FIGURE 1.—*Left,* Wind-driven siren on Piper Cub seaplane; *right,* electric siren on Stinson seaplane.

Besides the use described above, airplane sirens can serve other purposes, through prearranged instructions. For example, men in danger of being trapped on a fire may be warned to get out by a blast, or series of blasts, of an aerial siren. Ground messages to the airplane can be acknowledged by means of the siren. Sirens can be helpful in contacting lost persons, persons to whom you are dropping emergency messages, field parties you are trying to contact or locate in the woods. On the Superior, we have found the combination of siren and message-dropper very effective in communicating with ground parties who do not have radio. Another use of aerial sirens which has paid off has been to alert ground parties on fires and other projects to go to the nearest field radio to receive a specific message. Spot fires have been found quickly by ground crews searching for them after the airplane siren was sounded directly over the spot fire to point out its location.

Costs of sirens will vary greatly according to the type and size used. Electric sirens cost from $25 to $50 and may be purchased from most fire equipment suppliers. However, most fire control agencies have one or more usable truck sirens lying around or can divert one from one of their trucks. Wind-driven sirens are quite hard to locate these days, despite the fact that they were required equipment on seaplanes not too many years ago to warn water craft the seaplane was approaching to land. We finally secured one for $6. However, indications are that there are a few on the used equipment market which can be found by advertising in trade publications.

CRAWLER TRACTOR PULL-OUT CHAINS

STUART B. MCCOY

Ranger, Wisconsin Conservation Department

Forest fire tractors pulling plows must go where the fire is burning. Mud holes, small creeks, peat bogs, and rock and stump straddling all present situations where tractors get hung up for lack of firm footing. Being stuck while a running fire is spreading is most aggravating, and often seriously time-consuming.

FIGURE 1.—The pull-out chain.

Wisconsin solved this problem by the use of home-made pull-out chains that are now standard equipment on 70 tractors. They are simple to build and have paid for themselves many times over.

Essentially, the pull-out chain is nothing more nor less than a 5-foot chain with the round hook retained on one end. The grab hook is removed and replaced with a heavy-duty forged hook shaped to fit the edge of the track plate. In order to catch the other side of the track plate, a second identical forged hook with a loose ring is provided to slide on the 5-foot chain. By sliding on the chain the two hooks will fit any width plate, and when pull is exerted on the end of the chain, they tighten to hold securely. Each track needs a chain.

Usually all that is necessary to extricate a hung-up or stuck tractor is to give it something solid underneath upon which it can exert its temporarily useless strength. The round hook end of the chain is now fastened around a cut pole, old log, loose stump, or any available material that will provide a solid footing when pulled under the track. In soft mud, several poles cut to a length a little greater than the total width of the tractor and pulled underneath as a bundle will cause almost immediate traction.

The grab hook hanging on the ring connecting the short and long pieces of chain is an auxiliary feature. It provides a quick method of attaching any log chain to the pull-out chain in case the round hook is damaged or lost. Where sufficient additional chain is available, the pull-out chain may be fastened directly to a more distant live tree or solid stump for anchorage.

The pull-out chains may be fastened on the tracks either in front or rear. When power is applied to the tracks, care must be taken to see that the movement of the tracks will pull the chain underneath. The lug hooks are easily released as solid footing under the tracks releases tension on the chain.

Figure 1 shows a pull-out chain used with 7,500-pound tractors having 13- and 14-inch treads. The specifications shown below have been found satisfactory for this weight tractor. For other tractors, specifications can be changed accordingly.

Lug hooks forged from 1¼-inch axle steel. Lug-hook rings made from ⅝-inch round, 2½-inch inside diameter. Grab-hook ring made from ¾-inch round, 3-inch inside diameter. Chain is ½-inch electric welded, about 5 feet long. Grab and round hooks standard ¾-inch hooks. Short chain about 12 inches; longer chain about 48 inches. Ring on grab hook prevents loose lug hook from working too far down chain toward round hook.

Handling Fingerprint Records

Under the present conditions of an unfavorable labor market, very likely both private and public protection agencies are experiencing difficulty in handling the paper work involved in hiring temporary seasonal workers. This problem is complicated by the necessary loyalty checks for all Federal and many State and private protection jobs.

The fingerprinting of applicants for work on this forest used to be one of the major chores involved in the processing. Several members of our permanent force were trained to take fingerprints, but time spent at this job was badly needed elsewhere. Time was also taken up when many of the fingerprint records were returned as unsatisfactory and had to be done over. Since men whose jobs were to last less than 180 days were not fingerprinted, we had no check on them except their own statements.

We now have a very satisfactory cooperative arrangement with El Dorado County Sheriff Rowland Morris. Many of our candidates are not the highest type of individuals, and the sheriff's office is as happy to get a check on them as local forest officers are to get help on the checking. Eldorado keeps the sheriff supplied with fingerprint forms, and the deputy or undersheriff makes two fingerprint records for every applicant. One set of prints is used for the loyalty check and goes through the Forest Service with other forms if the employment lasts 180 days. The other set of prints is checked with law-enforcement agencies cooperating with the sheriff's office, and a complete report on the individual, so far as state-wide criminal activity or tendencies are concerned, is returned to the forest supervisor usually within 2 weeks.

Last season several men were spotted by this check who were either wanted or were serious risks. We always send an applicant for fingerprints before he makes out an application blank, and many have failed to report to the sheriff's office when confronted with the necessity for a fingerprint record. Early elimination of such applicants saves much time. Under our old system, some shady characters who were aware of the time lag involved in running down records would deliberately falsify their applications and work through a season before the checkup caught them. Our cooperative system has eliminated this time lag in processing, and has helped the Eldorado select the best men available for employees. It has also made possible a worth-while saving in time and money.—E. H. ELLISON, *Administrative Services Officer, Eldorado National Forest.*

A PORTABLE LIGHT FOR FIRE FIGHTING TRACTORS

Division of Forestry, State of Washington Department of Conservation and Development

In the control of forest fires much valuable time can often be gained by operating bulldozers at night. Usually on large or difficult fires in the State of Washington, private operator's tractors are employed. These machines normally do not have night

FIGURE 1.—This portable light saves many hours of daylight operation on fires by enabling tractors to get into position during the night.

lights. At night tractors operating without lights often find it impossible to (1) get to the fire when it is not adjacent to well-established roads and (2) to build fire trails once they are there, because rough terrain makes the light from the fire inadequate for safe operation.

Both of these problems have been partially solved by a portable tractor light that was developed by Tom Almont at our State Forestry Automotive Shop. This light was designed for quick installation on any type of tractor having either a 6- or 12-volt battery (fig. 1). Ease of installation is, we believe, one of its principal attractions over other lighting systems that we are acquainted with. The combination chain-bolt clamp allows the light to be fastened to any size pipe, angle iron, or screen. In some instances the light has been attached to the exhaust pipe.

The wiring for this light is very simple. During the 1952 season all of our lights were equipped with 6-volt, seal-beam elements. The clamp holding the light in place serves as the ground. A single wire leading from the light is fastened to the battery or generator by means of an alligator clip. On a 6-volt battery, the clip is fastened across the whole battery or to the generator terminal, and on a 12-volt battery it is fastened one-half way across. Since some battery connections are too hard to get at because of the battery cover, we now plan to carry both 6-and 12-volt, seal-beam units at all times. Thus, it will always be possible to make a connection directly with the generator as needed.

These portable lights are built from automobile headlights and scrap material that would ordinarily be waste around the shop. One costs approximately $6. Field supervisors' and fire control assistants' cars carried these lights throughout the 1952 fire season, ready for use whenever the need arose; district wardens' pickups will also carry them in the future.

Inexpensive Message Tubes for Air Use

For quite a few years the Shasta National Forest has used an inexpensive message tube for dropping to ground crews from patrol and cargo planes. These tubes are made from condemned 1½-inch CJRL hose, and have an over-all length of 13 inches. An 8-foot strip of cheap yellow flagging material is riveted to one end of the tube, and a 3-inch beveled tab is cut in the opposite end. This tab, tucked in, closes the tube. Yellow is used for the streamer because of its high visibility.

This tube and streamer is also used by ground crews to signal their needs for water or food to a plane by making a W or F. The plane then requests information on the amounts needed, and the ground crew responds by showing a single bar mark for one 5-gallon can of water, two bars for two, etc. If the crew has enough tubes, they can signal with a numeral. The same applies to food except that the bar or numeral indicates the man-days of food needed.—MERVIN O. ADAMS, *Forest Dispatcher, Shasta National Forest.*

A "DR. PEPPER" FIRE REPORTING SYSTEM

ED. KERR

Press Representative, Louisiana Forestry Commission

Through what he calls a Dr. Pepper fire reporting system, State Forester James E. Mixon of the Louisiana Forestry Commission knows exactly how many fires are raging, what size they are, and how many units are fighting them at any hour of the day. The system gets its name from the fact that fire reports are received in the central office at 10, 2, and 4 o'clock each day.

The 10 o'clock report covers fires occurring the night before and the other two are devoted to fires occurring that day. Status of the fires is also included, so the State Forester can keep abreast of how many fires are still going and how many have been contained. In other words, the State Forester in Baton Rouge knows at all times the fire activities in the remotest corner of the State.

A huge area in the front room of the central office accomodates a map of Louisiana (fig. 1). Each tower is represented by a small bulb that is lit when the tower is manned, turned off when the towerman leaves his post. All lights are actuated by a control board facing the receptionist, who is radio and telephone operator.

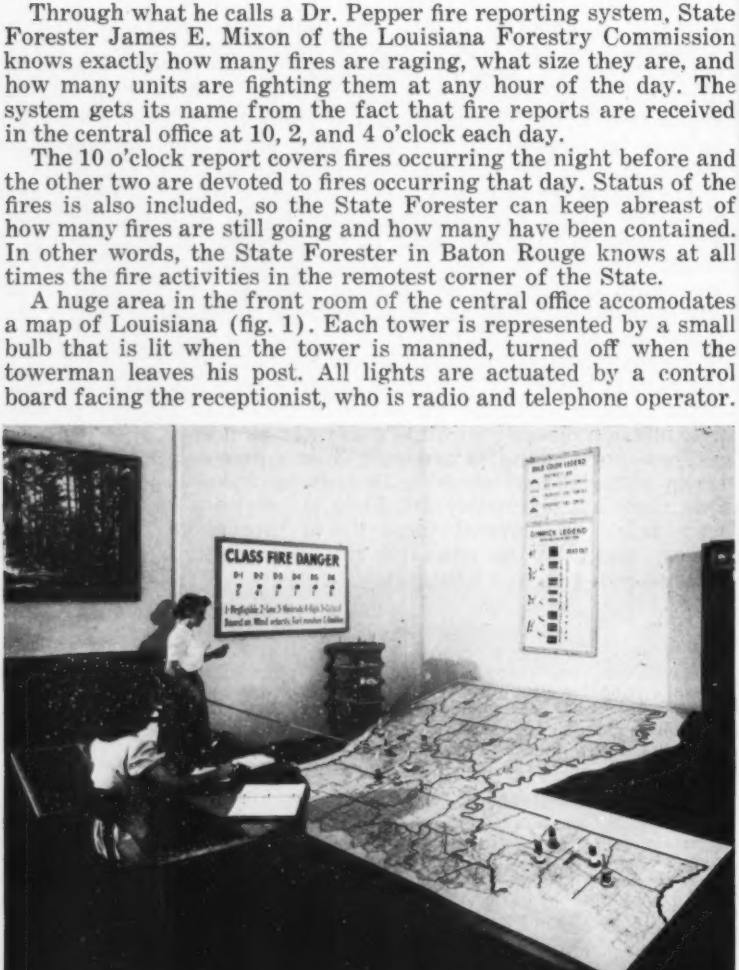

FIGURE 1.—The "Dr. Pepper" map.

When the radio operator receives a report, she immediately proceeds to record the information on the floor map. This is done by means of plastic "gimmicks" that have a hole in their centers, and are of different sizes, shapes, and colors. When they are slipped onto a wooden stake and placed on the map in the approximate location of the fire, they tell the complete story of that fire's existence.

Take for example a fire occurring in Sabine Parish. It is reported to be 500 acres in size and is being fought by two commission units and one unit sent by a forest industry. It is reported on the 2 o'clock signal as the second fire that day in Sabine and has not been contained.

The operator puts a red ring on the stake first to represent the hour reported, then a pink cube representing a 500-acre fire, then two pink hexagons symbolizing commission fire-fighting units, and one pink triangle for the forest industry unit. If the fire had been reported "dead out," a black cylinder would have been placed on top of the other symbols. A number two tag is then placed on top of the stake, showing that this was the second fire reported in that parish that day. All numbers start over again at the beginning of a new day.

The map, which presents a striking assortment of variegated colors toward the end of a day in fire season, has been responsible for opening the eyes of many a citizen to the forest fire danger in Louisiana. Such is its appeal that the commission office is the only State department chosen by a local sightseeing service to show its tourist customers.

All-Purpose Dispatch Map

The Georgetown Ranger District of the Eldorado National Forest, Calif., has been fortunate enough to have most of its area covered by the 7½-minute quadrangles of the U. S. Geological Survey, having 40-foot contour intervals. These topog quads and, for the extreme eastern part of the district, a Forest Service planimetric map enlarged to the same scale fitted together provide a composite district map, the most up-to-date available. The map, approximately 6 by 9 feet, almost covers one wall in the office.

It makes a very effective and accurate dispatch map when 12-inch azimuth circles are added for each lookout. The scale is large enough to put in all roads, trails, isolated uses, and other information important for fire control purposes. The map attracts attention of most office visitors, and its use for general information is superior to smaller scale maps. Found section corners, road log distances, and mining claims have been added, and it is believed that as more information is added the map will give a better basis for land use planning.

Time has not permitted the development of "single reading" fire location from one lookout through use of the vertical angle to the extent that it is believed possible, although preliminary checking has indicated that we can expect considerable accuracy.—GEORGE I. RAMSTAD, *District Ranger, Eldorado National Forest.*

MEETING THE HUNTER PROBLEM DURING SERIOUS FIRE WEATHER

JACK I. GROOM

Fire Staff Assistant, Fremont National Forest

Each fall the Fremont National Forest is host to some 25,000 hunters. The hunting season varies, but is usually from about October 1 to 18. This forest is located in south central Oregon close to a high desert area where very light fall rains are often slow in coming. Past records show that the forest has had a number of large fires caused by hunters' carelessness. There are two possible ways of preventing such fires: close the forest to all entry or carry on an effective fire prevention campaign with the hunters. After having tried both this forest feels that hunter contact is the better method.

One way of making sure that every hunter group is contacted is to require campfire permits and then keep ranger stations open so that hunters can get permits without too much delay. When the permits are issued, time is taken to inform the hunter of fire danger and to gain assurance that he will do his part in the prevention of forest fires. Maps and other information are available at these stations, and an effort is made to be as helpful as possible to these people so that they will feel that they are the guests of the Fremont National Forest. Fire permits are issued for spots which so far as possible are at springs or creeks where safe fires can be built. Several times each year emergency calls come through for hunters, and because of the permit record it is usually possible to find them in a short time. In 1952 we issued approximately 5,000 campfire permits.

Patrolmen are taught to be helpful and cooperative in their contacts with hunters. They are, of course, constantly on the lookout for fire situations that need correcting. When a campfire is found in a danger spot, the hunter is told in a polite manner why it is dangerous and is helped to make it safe. The objective is to educate people to be better forest citizens. Sometimes when a State fire law is violated, it is necessary to take the case to the local court. One of the main purposes of patrol is to catch and correct such a situation before a violation occurs.

As a result of the above process, campfires are generally not much of a problem. The biggest fire problem results from warming fires that hunters build, usually early in the morning, when they are away from their camps. Warming fires are more of a problem in seasons when light rain falls than they are during very dry seasons. Light rains change the fire danger for only a short time, but some hunters think that the fire season is over and neglect to put out their warming fires before they move on. Likewise, smokers get careless while hunting and start fires by throwing away burning matches and tobacco.

In both of these cases, the fire patrol is not able to check the fire because it occurs away from main routes of travel. The only way to attack this problem is to impress each hunter, both at the

ranger station and in the field, that there must be *no warming fires* and that they should stop traveling when they wish to smoke and then make sure their smoking material is dead out when they leave. Here again the proper approach is through reason, which takes a little more time but gets much better results than just telling the hunter that what he is doing is against the law.

Although much can be done by patrolmen and issuers of campfire permits to persuade hunters to leave a clean camp, dirty camps are a constant problem during hunting season. There is something about getting out in the open woods that causes people to abandon their usual orderliness. They just come to relax. The patrols work constantly on this matter and most people cooperate willingly, but when you entertain 25,000 people there are a great many who don't seem to get the point.

In all hunter contacts, the idea is put forth that if forest fires result from their activities, they should naturally help to suppress them. This line of reasoning is accepted and applied, and usually a hunter will have a small fire under control before a fireman gets to it. Hunters are proud of the fact when they have helped stop a forest fire, so every opportunity is taken to commend them. The reduction in acreage burned as a result of hunter fires is a testimony to the success of our hunter-contact program.

	Hunter forest fires	
Year:	*Number*	*Acres*
1946	19	1,408
1947	12	1
1948	9	10
1949	32	70
1950	25	6
1951	10	([1])
1952	5	([1])

[1]Less than 1 acre.

In trying to eliminate the forest hunter problems of unsafe campfires, warming fires, smoker fires, and dirty camps, it is necessary for every hunter to accept the idea that he has a responsibility while he is in the woods. This acceptance can best be gained if he understands what that responsibility is, and is given the feeling that he is welcome on the forest. It is essential that as many hunters as possible be contacted personally. This means that an office at rangers' headquarters must be kept open as many hours and week ends as necessary to serve the people, and that enough employees must be on hand to issue permits and help with hunter information so that no one is unduly delayed. To effectively contact hunters in the woods, a careful job of planning must be done before the hunting season starts. All camps should be visited at least every other day and more often if possible. Every employee needs to be as helpful as he can because the hunters' good will and understanding can help lick the problems involved. Then too, a national forest belongs to the people of this Nation, and it should, if possible, be available for their use and enjoyment.

XZIT—ITS EFFECT ON THE RAILROAD FIRE PROBLEM

RALPH C. BANGSBERG

Fire Control Officer, Shasta National Forest

For many years the Shasta National Forest has been struggling with the knotty problem of how to reduce the number of fires caused by railroad operations. Running through the forest is 116 miles of main-line Southern Pacific right-of-way, 46 miles of McCloud railroad, and 15 miles of Great Northern track, a total of 177 miles of main and secondary line.

The most difficult problem has been concerned with the 116 miles of Southern Pacific's main line. For at least 20 years railroad officials and forest officers have been holding conferences, inspecting right-of-way, laying out work plans, advising, and trying to figure out how to prevent these operation fires.

Following the route of the Southern Pacific Railroad north from its entrance to the Shasta Forest, it first enters the steep Sacramento Canyon. This is a timbered area varying from precipitous shale slides and cliffs to steep, heavily wooded slopes. Timber is largely ponderosa pine, Douglas-fir, white fir, and cedar, with occasional black oak and manzanita thickets. Climbing out of the canyon north of Dunsmuir the railroad winds over arid plains and mountains that support large areas of flash fuels, cheatgrass, bunchgrass, extensive fields of dense manzanita, sagebrush, old slash and cut-over timber stands. For the most part this is an area of little rainfall with only moderate snowfall at the highest elevations (about 5,000 feet) on the right-of-way.

In 1942 an extensive program of hazard reduction was started with co-op money from the railroad. This burning of right-of-way action materially reduced the number of starts, but we were still averaging 25 to 30 fires a year.

From figure 1 you can readily determine fire incidence for the years from 1932 through 1952. As a matter of interest, acreage burned follows the peaks of the curve. The dramatic increase in number of fires in certain years can be attributed to increases in volume of traffic, severe fire danger, type of engines used, war traffic, etc. Most noticeable is the low of three fires in 1933 at the height of the depression when there was almost no traffic over the line, in contrast to the low of three fires in 1952 when there was more traffic than in any other year except in 1941 and 1942 at the start of World War II.

In 1952 the tonnage was heavy and fire dangers varied from medium to extreme. There were no summer rains to lower these fire dangers. A tie-up of Western Pacific lines, because of a burning tunnel, shoved additional freight over this line along with

freight that was detoured because of damaging earthquakes in the Tehachapies. New trainmen, engineers, and crews were working over the line. There had been no increased hazard-reduction effort. In the light of previous experience everything favored an increase of right-of-way fires.

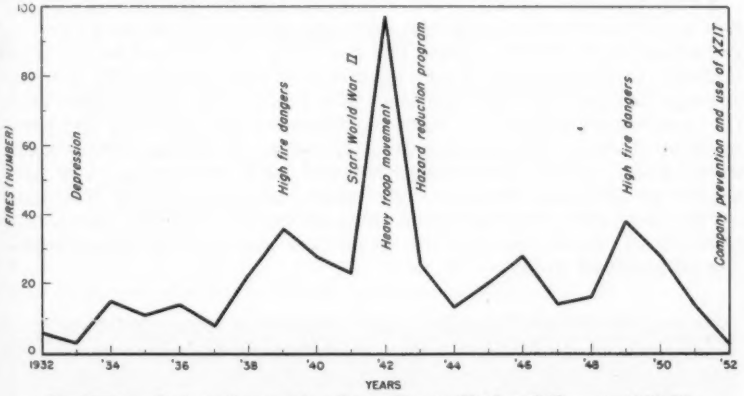

FIGURE 1.—Railroad operation fires, Shasta National Forest, 1932-52.

Several factors contributed to the greatly reduced fire incidence in 1952: (1) The Southern Pacific doubled its prevention effort with its employees. (2) Diesels, which have a dynamic braking system, were used in considerable numbers, lowering brakeshoe fires. The Diesel operates much like an automobile coming down grade in low gear, working against compression. (3) Better mechanical maintenance and inspection of stacks, screens, and other fire-causing mechanisms. (4) Last, but not least, the adding to fuel oil of a carbon-reducing agent called XZIT. XZIT, through its chemical action, cleans oil tanks, fuel lines, removes soot and carbon from fire boxes, flues, and stacks, thus eliminating the exhaust of hot sparks when an engine pulls grades.

What has XZIT done to help solve the railroad fire problem? The answer is given best by the following record of fuel spark fires.

Year	*Fires (number)*	*Area burned (acres)*	*Damage (dollars)*	*Cost (dollars)*
1941	4	10	.....	100
1942	29	3,439	7,581	155,000
1943	4	(1)	.....	61
1944	5	183	176	18 300
1945	9	45	38	4,500
1946	11	141	412	14,100
1947	5	(1)	.....	60
1948	2	(1)	.....	80
1949	10	6	.....	987
1950	14	132	145	13,900
1951	11	26	.....	1,440
Total	104	3,983	8,352	208,528
1952	0	0	0	0

[1]Less than 1 acre.

Since there were 317 railroad fires from all causes for the period 1941-51, 33 percent of them were caused by fuel sparks, according to the above record. Thus, for the year 1952 it is reasonable to conclude that the use of XZIT accounted for at least a 33 percent reduction in railroad fires.

From the standpoint of the Southern Pacific, the use of XZIT has saved money for them through lowered operation costs and a reduction in fire claims cases. The company has decided to use this additive throughout the year regardless of fire season. The Forest Service has profited through the reduction of fuel spark fires and the consequent release of crews for other work, including the prevention of other man-caused fires. However, it is yet a little soon to draw any final conclusions. We will need more than one fire season to judge the long-run effects of the use of XZIT. The use of this additive plus an active interest in fire prevention on the part of all concerned may yet eliminate the long-standing problem of railroad fires.

Smokey the Bear Works for the Cleveland National Forest

Through the fine cooperation of the San Diego Seat Advertising Company, large metal Smokey Bear posters have been placed on twenty seats at bus stops in the most heavily populated sections of the City of San Diego. The signs, painted on a metal base, will remain in place until the close of the fire season and again be used starting about July 1. It is estimated that these signs will be viewed by upwards of a hundred thousand people each year.

Radio Station KFSD has purchased a record of the Smokey Bear song, and this is used as a theme on the weekly radio program conducted by the Cleveland National Forest. A separate verse is used each week for 4 weeks and on the fifth week the first verse is repeated. This catchy tune has brought forth many very favorable comments.

Through the assistance of the San Diego County Citizens Study Group on Forest and Brush Fire and Conservation Problems and in cooperation with the State Division of Forestry, some twenty papers in San Diego County are running weekly columns carrying a reproduction of Smokey and starting "Smokey Bear Says." In the news items that follow the entire fire situation, both State and Federal, is covered, including the number of fires that have occurred during the past week, weather, and fire conditions. A great deal of interest has developed throughout the area.

Several hundred members of the Smokey Bear Junior Forest Ranger Club have been appointed and, since the cards are issued only to those who have made contributions to conservation, membership is very much coveted by youngsters.—ROY H. BLOOD, *Administrative Assistant, Cleveland National Forest.*

"LITTLE LULU"—MECHANICAL FIRE LINE RAKER

JOSEPH JAEGER, JR.

District Forester, Missouri Conservation Commission

A recent equipment development of interest to men who construct fire lines by hand-tool methods in the central hardwood region is an adaptation of a commercially made power mower to a mechanical fire line raker (fig. 1). The raker has been given the name of Little Lulu by men using it. Experienced fire fighters who have seen this tool in operation were favorably impressed and expressed confidence in its ultimate success (fig. 2).

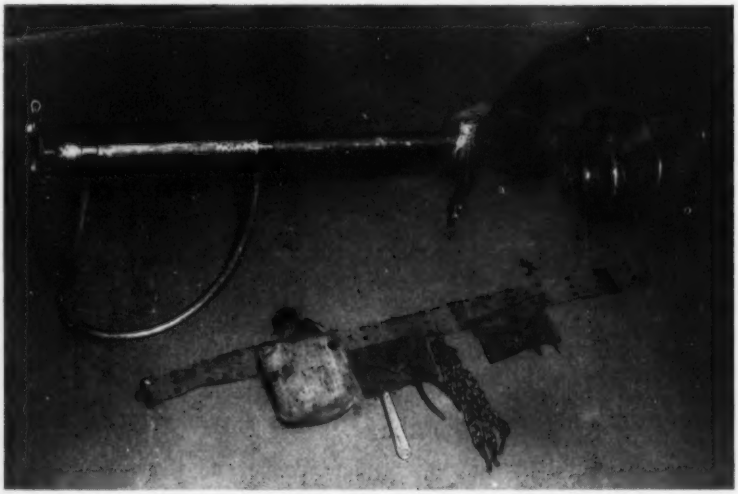

FIGURE 1.—The converted fire line raker tool and web cartridge accessory belt.

In 1950 a southern subcommittee of the Region 9 Fire Equipment Development Committee discussed the possibility of using a commercially made power mower as a tool in fire fighting. William E. Towell, Assistant State Forester of Missouri, Missouri Conservation Commission, offered to buy a mower and investigate its utility as a mechanical fire raker. The offer was accepted, and a mower was purchased and turned over to the Lake Ozarks Fire Protection District.

FIGURE 2.—Little Lulu in operation.

The mower received for development was a sickle-bar type with a 20-inch blade, power being furnished by a 1¼-h.p., single cylinder, 2-cycle engine. The over-all length of the mower was 54 inches, and it weighed approximately 24 pounds. The torque tube that transmitted the power from the engine to the head operated on an eccentric. The first step in development, therefore, was the conversion of the torque tube to operate on a complete revolution basis (360°). This was done by removing the eccentric gear from the transmission and replacing it with a specially tooled helical gear.

The next step in the development concerned the raking head that would perform the actual leaf and grass raking on the fire line. After thorough investigation and various experiments, a small steel plate with six steel spring tines attached was added to the end of the torque tube. However, when actual field tests were made, the tines broke too easily. Further experiments resulted in attaching three chains to the plate, and thus far they have proved satisfactory in field tests. A piece of ⅜-inch galvanized pipe bent in the shape of a U was attached to the lower end of the torque tube to serve as a guide in regulating the depth of the fire line as well as a safety guard to prevent the operator from placing his foot in the whirling chains. It is of interest to note that Little Lulu makes fire line while going either forward or backward.

So far the results of Little Lulu on actual fires have been very encouraging. It makes a fire line about 12 inches wide, and if a wider fire line is desired, that too is possible. The rate of fire line construction varies from 1½ minutes per chain in open forest to 3 minutes per chain in thick broomsedge mixed with hickory and sassafras reproduction. Although a three-man crew is preferred, two men can operate this piece of equipment. The lead man locates fire line and with his brush hook chops out any material that might interfere with the operation of Little Lulu. The lead man carries a web cartridge belt to which is attached a 1-quart canteen filled with extra fuel, three extra chains for the line raker, and two small pouches containing two screw drivers, an 8-inch crescent wrench, a pair of pliers, an extra spark plug, an extra starter rope, and five cotter pins. The second man operates Little Lulu and does the actual line building. When a third man is available, he checks fire line and backfires the line when necessary.

Several shortcomings have been noted on Little Lulu—a small tank for fuel, no automatic way of stopping the engine, no clutch for throwing line raking head out of gear while the engine is still operating, and inconvenient location of the throttle.

Since the development of Little Lulu, the manufacturer of the original power mower unit has brought out a new one. We are developing it as a mechanical fire line raker, and call it Big Lulu. The added features of Big Lulu are a 1-quart gas tank, assuring 1-hour operation at full throttle; a friction clutch that gives easier starting and better maneuverability; a larger engine, rating 2 h.p. at 4,000 r. p. m.; a well-located throttle control; direct drive from the engine, eliminating the transmission gear box; and an automatic short button for stopping the engine. Weight of the larger model is 26 pounds.

From the development viewpoint there will be only one Little Lulu. The pioneer efforts on this piece of equipment produced good results, and they are being used in the development of Big Lulu. It is anticipated that Big Lulu will be in operation by the first of the year.

Sign Posting With a Staple Machine

For the past 3 years the Angeles Forest has tested various types of staple machines as a substitute for tacking paper fire posters. A stapler, costing approximately $8 and using ¼-inch staples, has been found to be the best all-around tacking tool. All sizes of paper poster signs can be quickly and efficiently mounted on wooden backboards, trees, telephone posts, bulletin boards, or any other wooden surface. The ¼-inch staples when applied 6 to 8 inches apart do a better job of holding paper signs in place than the regular poster tack.

Our field men have found this tool to be faster and more efficient than the tack hammer with its elusive tacks. They have also used it for tacking tar paper in building construction and for temporary repairs to torn tents and fire fighters' jeans. The uses for this handy tool are unlimited. Further information may be obtained by writing to the Forest Supervisor, Angeles National Forest, 1443 Federal Bldg., Los Angeles 12, Calif.—HARRY D. GRACE, *Fire Control Officer, Angeles National Forest.*

FIRE CACHE WAREHOUSING DURING A HEAVY FIRE LOAD

W. F. CLARKE and A. B. EVERTS

Region 6, U. S. Forest Service

Region 6 maintains five fire caches. Those at Pendleton, Bend, and Grants Pass, Oreg., are 500-man caches and are on first call for equipment for the forests nearest them. The 600-man cache at North Bend, Wash., supplies all the Washington forests except the Gifford Pinchot. The 5,000-man regional cache is located at Portland, Oreg. It is on first call for the Gifford Pinchot, Mt. Hood, Siuslaw, and Willamette Forests. In addition, it backs up all the outlying caches on replacements.

Generally, when one of the smaller caches has sent out tools and equipment for from 200 to 300 men, replacements are made. This is not a hard and fast rule but is determined by consultation with the regional fire dispatcher, who bases his decision on the over-all regional fire situation at the time.

When several project fires are in progress at the same time, it is not uncommon for tools and equipment from one of the smaller caches and the regional cache to be dispatched to the same fire.

FIGURE 1.—Dirty hose in from the fires to be washed, tested, dried, rolled, and stored away. If rains persist, the hose must be dried inside. During the latter part of the 1952 fire season, 80,000 feet of hose and 52 pumpers were shipped from the Portland fire cache.

The regional cache is much better equipped than the smaller caches for reconditioning used equipment. For this reason, nearly all of the equipment coming off a fire comes into Portland. The outlying caches are then "spiked" up to their plan with "ready-to-go" equipment from the Portland cache.

It frequently happens that considerable fire equipment is out on late fall fires. Then come the rains, welcome to all, even though they are hard on equipment. Then the trucks start moving back into the Portland cache wet flies and tents, thousands of feet of dirty hose, musty and damp sleeping bags, rusty mess gear and tools, smelly ranges (figs. 1 and 2). In the field it's all over. The boys go back on their regular jobs, try to wrangle a few days' leave to hunt or to just plain "relax." In the fire caches it's just starting.

FIGURE 2.—A corner of the cache where mess equipment is reconditioned. Magnus No. 1-DX cleaner is used in vats to loosen rust. All liquid gas ranges and griddles are also soaked in this solution and then "steel wooled." Ranges are cleaned of all paint and then paint sprayed again.

In the spring months, when everything is shipshape and ready to go, a visiting fireman, looking over our regional cache is apt to remark: "What in the world do you do with all this equipment?"

If, during the past 2 years, this same fireman had seen our cache in the late fall, he would most certainly qualify his spring remark: "What are you going to do if you get another fire bust?"

Indeed, the April and October appearances of the cache bear no similarity; for, while we still have sufficient stock of some items, we most certainly are scratching the bottom on others. In the fall

of 1951, it was necessary to fly in scarce items from the Region 1 warehouse at Spokane. This back-up by Region 1 made it unnecessary to make emergency purchases on the open market to the extent that otherwise would have been necessary.

In 1951, 258,625 pounds of fire equipment were handled by commercial carrier. It is estimated that an additional 10 percent was moved in our own trucks. It is difficult to get an accurate figure on the savings made in using commercial carriers because so many factors enter into the computations, the most important being to what extent we are willing to overload our trucks. Generally, we can make out cases for savings of from 17 to 50 percent by using commercial carriers.

Constantly we work toward ways of improving our packaging, cleaning, storing and shipping. A few items may be of interest:

Mess equipment.—There are 271 items in a 25-man mess outfit, not counting the lunch sacks and bags and paper towels. It takes 4 of these to make up a 100-man outfit, or 1,084 individual items. For several years the region has been using paper plates, cups, and bowls, and plastic knives, forks, and spoons. Last fall and spring we removed all the tin plates, cups, and bowls, and all the knives, forks, and spoons from these mess units—all small items, but time consuming to clean after a fire—and replaced them with paper and plastic dishes and mess utensils. This one move, alone,

FIGURE 3.—The shipping boxes on the right contain 5-burner liquid gas ranges and accessories. The slats between the boxes enable the tines of the lift fork to pick up a single range. Kimmel stoves and dropping cans for hot foods are handled on pallets.

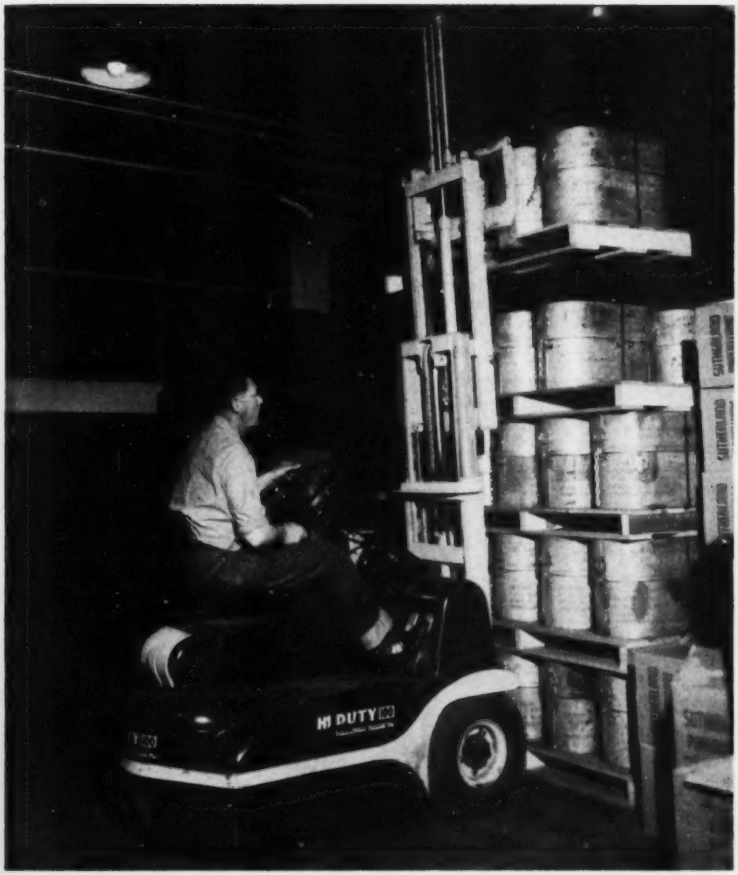

FIGURE 4.—Lift truck handling four 25-man mess outfits on a single pallet.

eliminated 686 items needing reconditioning in a 100-man outfit, and the field is well satisfied. Extra paper and plastic gear go out on all fire orders. Obviously use of this gear on a fire is much more sanitary as well as saves the labor of dishwashers in the fire camp.

Sleeping bags.—Cleaning and fumigating kapok sleeping bags, especially when they are wet, is a real "headache." This year, for the first time, we tried out paper sleeping bags (one-trippers). Field acceptance was good for early fires. For late fall fires we may need to add a blanket for extra warmth. This paper sleeping bag idea needs to be aggressively followed up. Elimination, to the greatest extent possible, of the kapoks will most certainly decrease the warehousing problem and, with it, costs.

Storage.—Storage and loading in the fire cache are greatly facilitated by use of a lift truck (figs. 3 and 4). Many fire shipments are made at night; with a lift truck, one man can handle all items. Warehouse space is also saved because equipment can be stacked higher than by hand labor. The ease of handling and safety are also important.

The first order for equipment on a fire usually is placed by asking for a certain number of 100-man outfits (camp and line) (fig. 5). Subsequent orders usually are by items—so many pulaskis, adz hoes, back-pack cans, pumps, hose, torches, etc. This region has discarded the boxing of hand tools. All axes, pulaskis, hoes, shovels, etc., are now bundled, six to a bundle, in burlap, ready for air dropping, mule or truck transportation. No longer is it necessary to keep a supply of different sized boxes on hand. There is no great loss if the burlap does not come back from a fire.

FIGURE 5.—A 100-man camp and line outfit (except for full complement of sleeping bags) on pallets ready for loading. Note the burlap packaged hand tools. The tank in the background is a Siskiyou hot-water heater. Efforts toward better palletizing of the 100-man outfit will be worked out this winter.

Only a few of the many problems involved in the behind-the-line back-up of the men on the fire line have been mentioned in this article. The opportunities for improvement are never ending.

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The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

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